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A survey of remote household energy use in rural Thailand

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Abstract

In the past, a goal of the Government of Thailand was for all households in the country to have access to electric power. Consequently, the installation of electric power generation system from renewable energy project was created in villages without electric power. The aim of the government project is to promote the use of renewable energy, especially solar PV systems. Solar Home System (SHS) will be the first solution to the no power supply problem. The purpose of this research was survey and distributive questionnaire in a sample solar home system use of rural villages in Thailand that are located in different regions. The main components of the systems (inverter and control unit) more than 50% were broken. The main cause of components broken because of, the SHS users have not enough knowledge for operate and maintenance system. The SHS user needs to increase electricity for use every day Result of studies as shown 78% of the households generate electricity only by SHS, 16.9% usage both of SHS and agriculture diesel engine and 5.1% generate electricity only by agriculture diesel engine. To satisfy the growing demand of energy in a village, a PV hybrid system can be designed by integrating an agriculture diesel engine. This is in order to supply greater power reliability to the community through introduction of a community micro grid.

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Keywords: solar home system; solar PV; agriculture diesel engine; rural village

1. Introduction

The characteristics of the residential energy consumption in rural areas are very interesting from social behavior and lifestyle change [1]. Much of the renewable energy electrification program that has been invested to designed and implemented the system in developing countries [2]. Thailand is now the largest PV user in Southeast Asia [3]. Somsak reports on the technical and social impact feasibility studies on a total of 214 systems installation of batteries charged by solar cells in Thailand. Socio-economic studies

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found that over 90% of systems generated from solar energy, there still remains systems users with damaged charging equipment in various conditions within 4-5 years after systems installation, while around10 % of systems remain intact [4].

The importance of this research work highlights Thai government policy. The aspiration is for villages in rural areas of Thailand still without electricity most are located in remote jungle areas difficult to access and on sea islands, for instance expansion of service areas by planting power cable poles is difficult due to a number of problems and procedures for permit to use areas take a long time. The research team came up with a concept to conduct a survey of the potential for solar PV system application today from 4 representative areas with differing geographical features in Thailand. All these four villages have solar PV installed in line with government policy. However, surveys conducted by the research team show impacts from the policy that will reveal facts from actual area users. Many research reports on identifying problems to set up the renewable energy programs success. Furthermore, many programs are still in barriers effect, and do not clarification of the cause for lacking on success of programs development. This research was conducted to determine the viewpoints and recommendations were provided on the technology about its capacity to respond or operate to full efficiency. Problems found in usage will explain the causes of various factors found and understand usage until it is necessary to turn to other energy technologies to supplement to satisfy the needs to use electric power of each household. In addition, awareness of the potential of solar PV system not used in villages can be developed as a blend of electric power generation system between solar PV for use with area irrigation or agricultural systems, and can be used as a guideline for public agencies to use as basic information for continued planning of usage of electric power for villages in rural areas of Thailand in the future.

2. Survey Data

Regarding to in 2004 the Thai government started a program aimed at electrifying additional rural areas that are inaccessible to the grid. The Ministry of Interior (MOI) financed the distribution of SHS to approximately two hundred thousand households in rural Thailand, occurring in two phases over two years. The PEA was responsible for contracting with various private companies (outsource) for the installation of SHS across Thailand. Approximately half of these systems are located in northwestern Thailand [5]. Many of these are in nationally protected forests and along the Thailand-Burma border, shown in Fig 1. This is to be accomplished by showing data on real-time system usage situations, damage that occurred with system administration, and guidelines on development of SHS to be the optimum electric power-generation system. Supporting information comprise information directly from system survey questionnaires and secondary information from various agencies concerned. Numbers of samples of SHS users in all 4 areas are as follows;

- Bann Bon Khao Kang Riang Village, Kanchanaburi Province amount of 69 households out of 281 households using SHS in the village.

- Bann Koh Jik Island Chantaburi Province amount of 23 households out of 135households using SHS in the village.
- Bann Klong Rua Village, Chumporn Province amount of 22 households out of89households using SHS in the village.
- Bann Pa Ya Sai Village, Chiang Mai Province amount of 21 households out of 22 households using SHS in the village

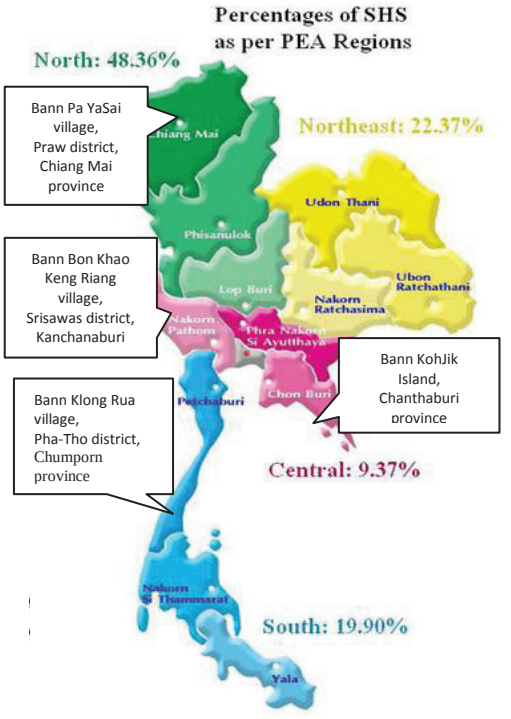

Fig. 1. Study areas and percentage of Solar Home Systems installed by region
(Adapted from Greacen, 2006)

3. Methodology

This research work applies the questionnaire as a research tool due to its ability to compile large amounts of information, comprehensively covering areas being studied. The questionnaire used is a tool for measuring personal viewpoints, feelings, and dispositions. This is accomplished by composing questions for the respondent to fill in remarks or make check marks in provided spaces. This questionnaire mostly enquires about facts and viewpoints of respondents in the form of personal interviews, taking notes, and observation combined. The structure of the questionnaire is divided into 3 parts altogether as follows; Personal information of questionnaire respondents, such as age, gender, number of households, Information on usage of various forms of energy, Information pertaining to solar PV system, such as knowledge on standalone solar PV system installed in homes or centralized systems. This is accomplished by conducting studies on usage patterns, administrative systems, and problem occurrence as well as system relevant viewpoints.

4. Finding

Solar electrification was found to provide direct and indirect benefits to the users of the systems, with many implications of a permanent nature. Reduction of kerosene use was the main impact of the use of PV system. Thus PV systems were found lead to less pollution, less hassle of kerosene lamps and get better light. Among the respondents who are living in southern Thailand around 17% were still using kerosene lamps and candles for lighting, and 19% of respondents were still using diesel generators for lighting. The remaining 64%

were only relying on solar PV for lighting. To summarize the results based on the survey five indicators: operation and maintenance, problems and implementation, system affordability, PV systems utilities and future development.

4.1. System operation and maintenance status

The villages were still using SBC, villagers elected board representatives to oversee and coordinate SBC, such as, inter-community and public agency coordination, collect systems maintenance fees of 20 - 50 baht per month per household its depend on the villagers commitment , including organizing individual household battery charging sequence, for instance.

Care, Maintenance, cleaning SBC, the systems maintenance committee will make advanced public announcements to villagers by requesting communal cooperation in systems cleaning, such as cutting grass, cleaning solar PV panels, cleaning battery charging facilities, for instance. Most of the time this occurs bimonthly and every important Buddhist day, such as Buddhist observance day.

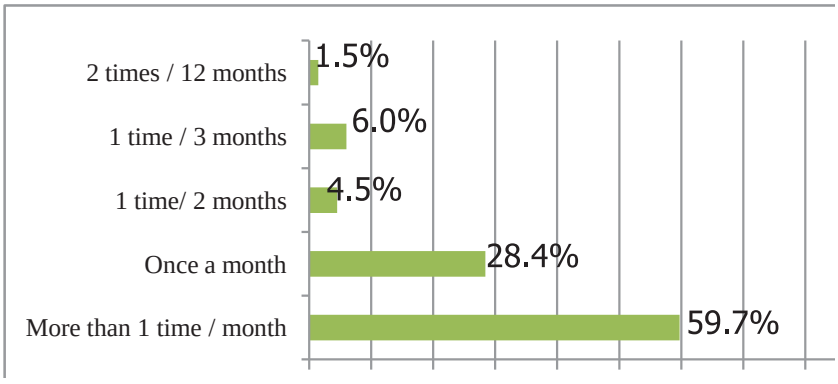

Fig. 2 . The frequency maintenance and cleaning of the SHS

59.8% respondents reported that they are cleaning and maintenance of the SHS more than one time a month, 28.4% reported that once a month cleaning and maintenance time line was used and only 1.5% reported that they were cleaning and maintenance 2 times per year (see Fig 2). The villages were still using SHS, the Government of Thailand has issued a policy that all Thai families must have electric power. PEA has been assigned to carry out installation of SHS project. As for survey villages, a survey was conducted of number of households in the village by government agents to find system numbers (number of Solar PV panels) required for installation. The PEA was responsible for contracting with various private companies for the installation of SHS across Thailand. Installation was completed in 2006; subsequently, after installation and systems checks conducted, the PEA conducted transfers of SHS to the SAO, whose duty it is to oversee public sector operations in village areas. The staffs in SAO, most acknowledge the policy of PV systems installation and usage within their areas of their jurisdiction yet cannot fully care for all PV users because of insufficient numbers of electricians in the organization, furthermore, lack of correct knowledge and understanding of SHS to provide assistance or repairs for SHS users, who require repairs to malfunctioning system. Within the SAO, mostly there is a lack of a process for managing and maintaining related to SHS, such as reserve equipment in SHS made available to SHS users, no knowledge of equipment warranty period in SHS, no clear procedures for sending equipment for repairs, or managing SHS users who have permanent electric power supply installed after SHS, for instance.

4.2. Problem from system and implementation

The first problem can called the communication problem that we have is that currently warranties from supervisory agencies (private companies) on parts of some system equipment have expired, such as battery charging controller. An important part of a long term functionality schema is to have a reliable communication network to communicate when systems are malfunctioning and warranties are being claimed. The PEA, who achieved the SHS program, intended the warranty information program to be supported by a communication network that had responsibilities stage in the solar PV projects. Fig 3. shows these stages.

In the occurrence of SHS have not functionally worked, the villagers were to contact the person who's energy representative of the village, who should contact the SAO office. The SAO, after receiving word of a problem, should contact the installation company, who should then send out technicians to the site of the failure. In addition, records would be passed along to the different levels of PEA as well.

Furthermore, a problem of usage found often in households is television reception, whereby while viewing TV if the charge on the battery is extremely low, with the alarm warning sound coming from the controller; however, villagers continue to view television broadcasts without paying attention to the warning alarm, the result is operations control system damage. More importantly, the problem of control unit by passing resulting in battery overcharging leading to lower electrolyte levels and plates emerging above electrolytes, leading to battery malfunction, effectively voiding the warranty immediately and villagers do not know who to contact when the system malfunctions within the terms of contract warranty

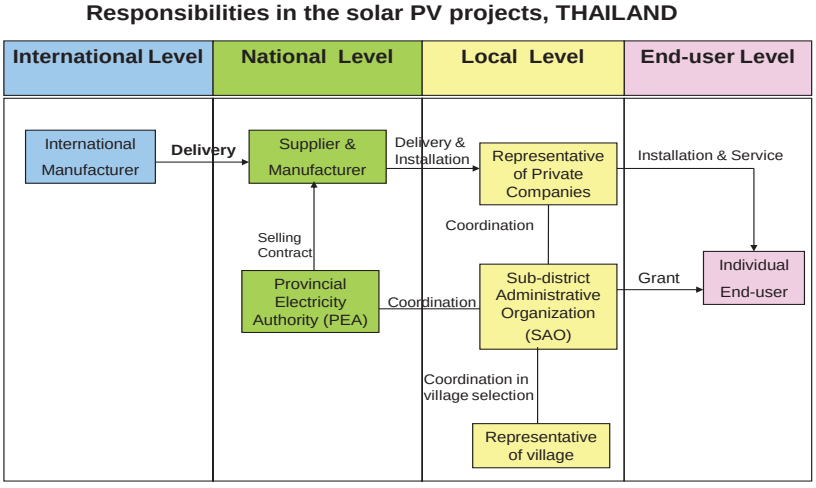

Fig. 3. Responsibilities in the solar PV projects

Moreover, if the battery charging controller were already defective, villagers would bypass the defective controller and directly charge the battery from solar cell panels for use. However, the SHS operates without battery bank, it makes them perceive as the system is not suitable. The battery should be installed in a well-ventilated space, covering its terminals with proper insulation caps. In this study, the problem with components of the SHS in remote villages is the inverter (59.7%), followed by the control unit circuit (53.1%) and 32.8% reported that the battery have not functionally worked after 1-2 years used as shown in Fig 4. Accordingly, performance and sustainability were evaluated for the SHS. It found that system sustainability was valued at about 1 year; this is due to problems of systems maintenance [6].

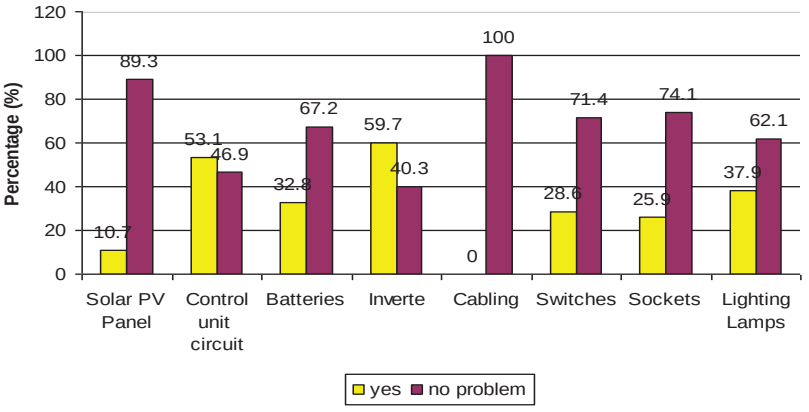

Fig. 4. Problems toward the components of the SHS

Most implementing agencies valued the importance of maintenance and monitoring and put into a regular maintenance system in place. A minority of program implementers did not emphasize maintenance and monitoring in their programs. This responsibility had been outsourced to authorized technicians or equipment suppliers. Where this responsibility had been outsourced to technicians or equipment suppliers, which were mainly government funded programs, dissatisfaction with the time timeliness of the maintenance was frequently reported by program implementing agencies.

4.3. System affordability

The cost of PV system is recognized as one of the main barriers for its use. The indicator of affordability was thus used to assess the capacity of the users to used and maintain the systems. In the concrete study areas all of the surveyed SHS were privately procured: the users owned the system and therefore met both acquisition and maintenance costs. The majority of users, though, pointed out that they incurred difficulties with paying for the system equipment replacement such as battery used for power storage in the village in northern Thailand due to they are low-income villagers.

4.4. PV systems utilities

Respondents were asked to rank the perceived benefits from a list. The list included increased quality of life, providing access to television and information, enabling users to increase their hours for study, enabling users to increase their hours of working after dusk, increased users' ability to generate income, greater mobility to work at night (due to an increase sense of security), increased employment opportunities, increased social activities, reducing the workload for women due to reduced needs for cleaning kerosene lamps, and increasing women's opportunities to work at night and to thereby increase the contribution that they are able to make towards family earnings. The results was found same as the evaluation of electrical service acceleration in Thailand which is the quality of life change in various social aspects that all mentioned it’s above [7].

4.5.Future development

The future development of this study was assessment potential solar PV system in the remote area by using agriculture diesel engine. The study details of evaluation were the components of Solar PV systems

and find the way to improve Solar PV system and might be other renewable energies also to hybrid renewable energy and agriculture diesel engine. According to the results of this survey, 78% of the villagers generate electricity only by Solar PV and 17% usage both of solar PV system and diesel generator; only 5% generate electricity by diesel generator. To satisfy the growing demand of energy in a village, a PV hybrid system can be designed by integrating an agriculture diesel engine. This is in order to supply greater power reliability to the community through introduction of a community micro grid.

5. Conclusion and recommendations

The survey results found that the financing mechanisms most commonly used in renewable energy programs in the region are subsidies. The respondents indicated that they are waiting for the financial support from government to be a significant factor of program success.

Another important finding was that while low-income people who's living in remote area were regarded to be a barrier, this study suggests that low-income people is no longer observed to be the primary, this is a mostly finding in a local life barrier. The lack of technical knowledge of their PV system, this barrier could be system maintenance was still a fairly difficult task [8]. The responses of those implementing Solar PV systems in the remote area not against the literature due to almost of respondents reported that they considered technical knowhow to be important in order for the basic maintenance and monitoring components of their program to be well designed. To promote PV system applications, it is necessary to set up an organization, which is solely responsible for training the users and system management after installation in order to enjoy the full benefits of both economic and social aspects [9]. Moreover, the fact that more than half of respondents considered it to be important for developing monitoring, more training practices and maintenance components is of concern as it is difficult to know how a project could incorporate a good service component without having good technical knowhow.

From the survey results we found that in all villages, Solar PV systems will be the first priority for renewable energy technology used and some household has agricultural diesel for generating electricity in case of energy supply from battery or Solar PV system does not meet energy demand. Due to the electricity supply can help the villagers to increasing work performance.

To develop power generating systems in the communities and possibilities for hybrid system between agricultural diesel engine and Solar PV system or other renewable energy. By, merging renewable energy technologies module and agriculture diesel engine to generate electricity by using the hybrid system with other household all around neighbours as shown in Fig 6:

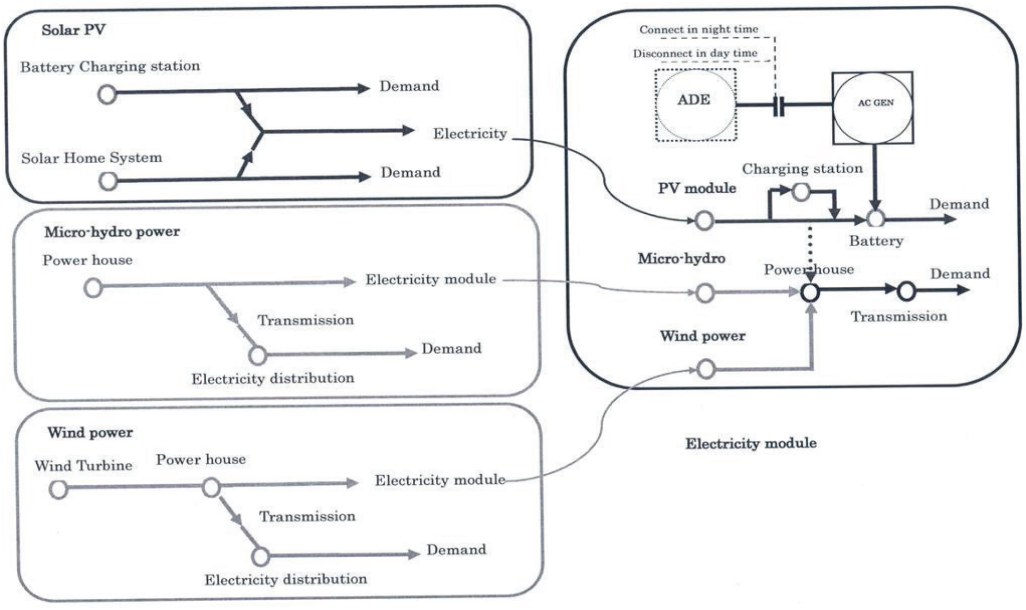

Fig. 6. Electricity module of hybrid system for rural household

Promotion of renewable technology at the village level decentralization planning approach has been attempted on a small scale [10]. In the case of rural Thailand, activities (lighting, entertainment and convenience) consuming the highest amount of energy for the residential [11]. The hybrid system between agricultural diesel engine and Solar PV system or others renewable energy systems approach ability of accounting for the above mentioned issue. Thus, the hybrid system is considered as the first step in more efficient system for the future development. Overall, Thailand has a good opportunity to take advantage of its sunny location to power its remaining non-electrified villages. Solar energy system is a good option for rural off-grid electrification. With careful planning and a long-term commitment to the people, which the government of Thailand has in abundance, use of solar energy technology will be very successful for rural electrification in Thailand.

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